DATA ANALYSIS

Driving Better Solutions

Metrics reporting that can lead to the best behaviors by Forrest W. Breyfogle III

Consider the time it takes someone to commute from home to work by car. The time to travel would not be precisely the same every day because commute time is a function of the amount of traffic encountered and delays from traffic signals, among other things.

Mathematically, this relationship is Y = f(X) in which Y is commute time and Xs are the inputs to the process (for example, the amount of traffic and traffic signals delays).

A commuter tracked her commute time for several weeks and observed it's typically 25 to 35 minutes. You can consider this commute-time variation "noise" within her commute from home-to-work process time.

When collecting daily commute times, she noticed two unusually long commute times. These two particular commute times took more than an hour, much longer than her typical 25 to 35 minutes commute time. A significant traffic accident caused one delay, and a snowstorm caused the other.

From a data analysis viewpoint, you can talk about specifics of exceptionally long commute times (for example, major traffic accidents and inclement weather conditions). But you shouldn't necessarily talk about the specifics of what occurred on a particular day within the 25-35 typical commute-time response.

Discussing the particulars of any noise datum point in a process response can lead to an erroneous conclusion and inappropriate actions relative to improving the magnitude of a process output response.

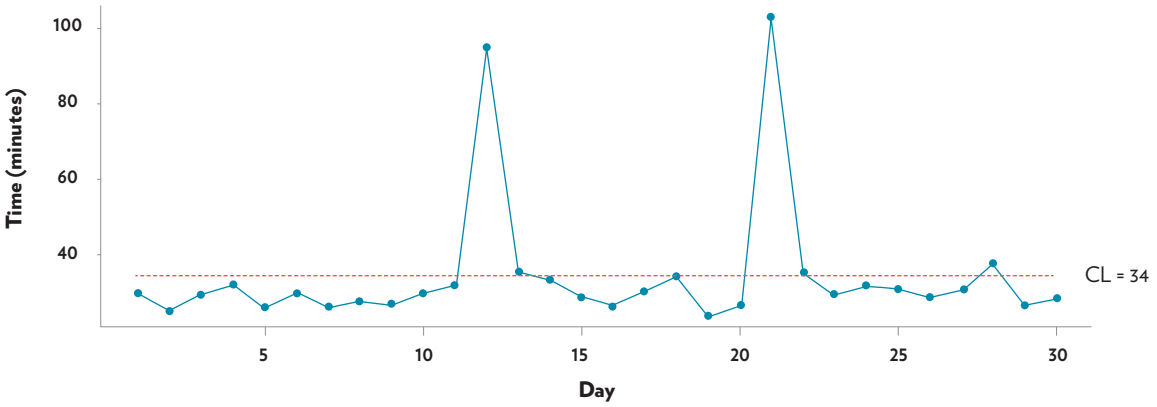
Goal setting

This commuter wanted to reduce her commute time; hence, she set a goal for her time to commute, similar to the measured goal-setting approach used in the organization where she is employed. She wanted her commute time to be no longer than 33 minutes. If a commute time exceeded 33 minutes, she would try to determine what happened during that commute and decide what to do so this problem commute time would not recurr.

But as noted earlier, you shouldn't focus on attempting to understand the specifics of what occurred for specific process response noise datum points. This home-to-work commute goal-setting scenario is similar to organizations using red-yellow-green scorecards to monitor the output

FIGURE 1

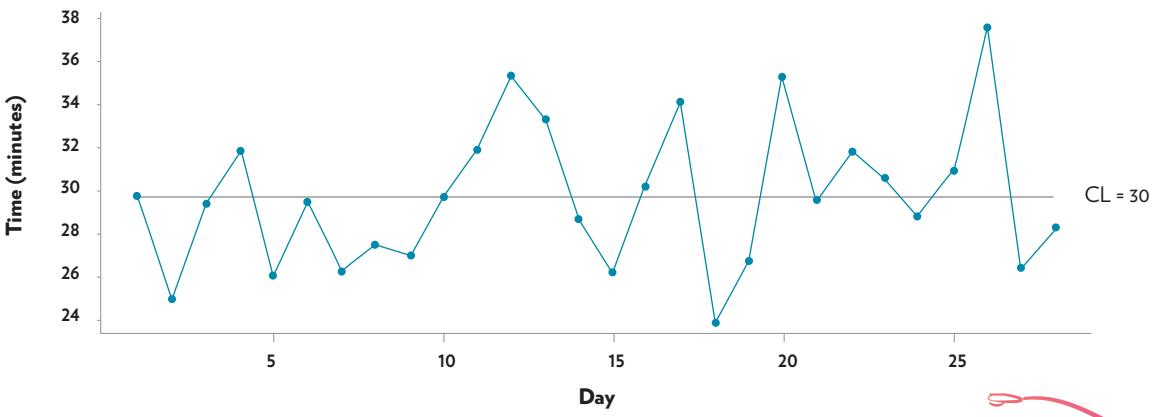
Commute time home to work: time-series tracking



CL = center line

FIGURE 2

Commute time home to work: time-series tracking (two atypical commutes removed)



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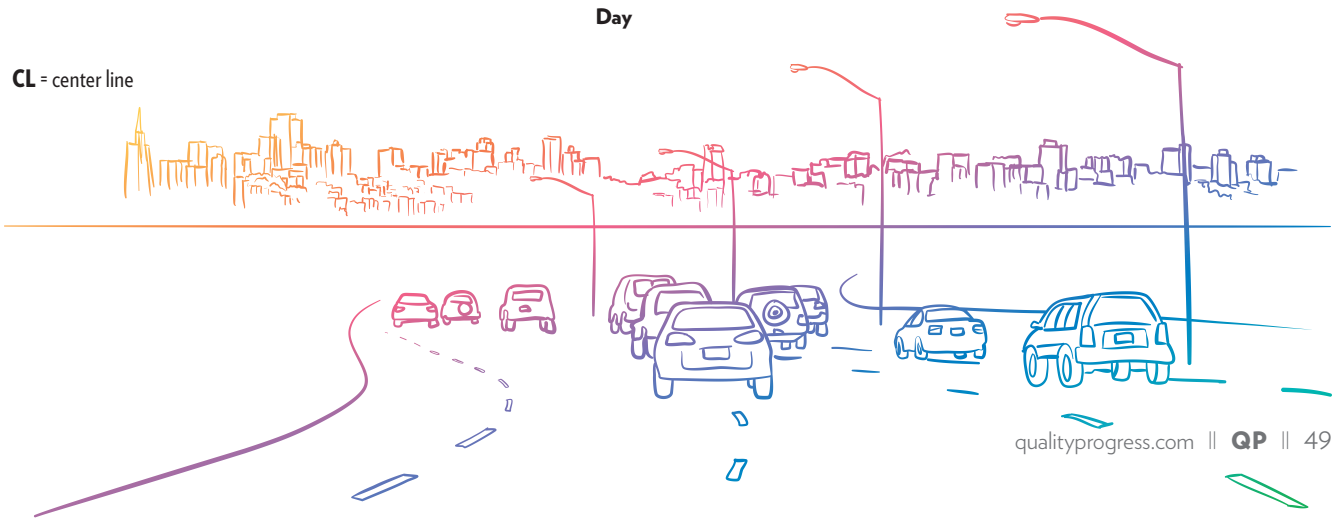


response from processes. A red color triggers action for this scorecard approach because a specific datum point missed a goal.

Red-yellow-green scorecards and similar goal-tracking methods for data points often can lead to firefighting noise variation as though it were abnormal occurrences, resulting in much organizational waste and even destructive behaviors.

In the 1980s, W. Edwards Deming highlighted problems with the commonplace meet-the-numbers goals management approach in his workshops' using his red bead experiment exercise.[1] The issues Deming described in this workshop exercise are no different than those of red-yellow-green scorecards.[2]

If this home-to-work commuter wants to reduce her typical commute time of 25 to 35 minutes, she must do something differently within her overall commute from the home-to-work process.

When reconsidering the X's in her commute time process, she thought of another process input X in addition to variation in delays from the amount of traffic and traffic signals on her commute. This additional input was the time of day when she left home to start her commute. She theorized that she might encounter less traffic if she left 30 minutes earlier, reducing her commute time significantly.

She was happy to see that data supported her theory. Data indicated that her commute time when leaving 30 minutes earlier was 18 to 22 minutes. This home-to-work commute process change significantly reduced her average and variation in commute times.

The primary message from this home-to-work commute illustration is that if a typical process-output response is undesirable, you must improve the overall process inputs, not attempting to uncover the reasons for specific measurement occurrences within the usual noise of a process response.

In organizations, it is vital to create metric reports that lead to the best actions or nonactions. The following sections use data from this home-to-work commute process to describe, in general, the tracking of a process response, goal setting and process improvement from a traditional metric reporting approach and a better 30,000-foot-level reporting alternative.

Traditional reports

Figure 1 shows a time series tracking of 30 daily commute times for the commuter's described home-to-work commute.

To examine typical commute times, you could eliminate—in this metric tracking—the two atypical occurrences caused by a major traffic accident and inclement weather, as shown in Figure 2.

This form of reporting often leads to setting a specific-day response goal if there is a desire to improve typical commute times. Figure 3 includes the commuter's 33-minute goal as a horizontal line. From this form of reporting, you try to understand why a goal was not met and decide the action to take so future events will not have the same problem that occurred on a specific day.

In Figure 3, there are five occurrences beyond the not-to-exceed goal of 33 minutes in this report. These data points can stimulate investigations for causal understanding that will provide little if any value.

Traditional metrics reporting often encourages reacting to the ups and downs of commonplace noise responses, leading to much organizational wasted efforts and even destructive behaviors.

Time-series charts do not separate typical process-output responses from atypical events (for example, a significant accident or inclement weather in our illustration) and quantify the expectation of a process output if there were no atypical events.

If a process output expectation (with no atypical events) is unsatisfactory, there is a need for process improvement that enhances the *overall* metric's response. Metric reporting giving focus to an understanding with an attempt to resolve the occurrence of individual unsatisfactory outputs over time does not provide this comprehensive process improvement insight. But 30,000-foot-level reporting can overcomes this shortcoming.[3]

30,000-foot-level reporting

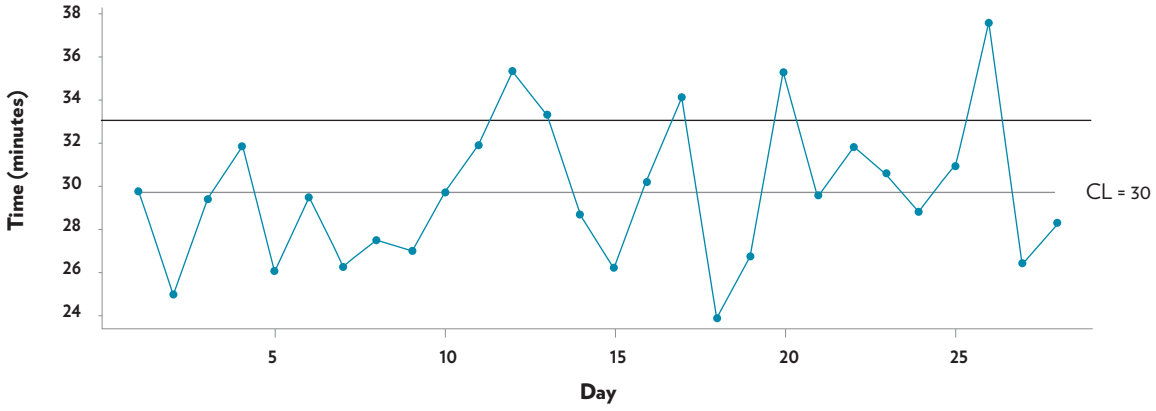
The 30,000-foot-level metric reports[4] shown in this section were created using a free app.[5-6] Figure 4 shows a 30,000-foot-level report of commute times before implementing the commuter's process improvement. The 30,000-foot-level report shown in Figure 4 has three components:

1. **The individuals chart** (left graph) assesses a measured response for stability from a high-level point of viewpoint—that is, a 30,000-foot-level point of view (not unlike a window's view perspective from an airplane in a flight of the terrain below). The math for creating this chart is the

FIGURE 3

Commute time home to work: time-series tracking (two atypical commutes removed)

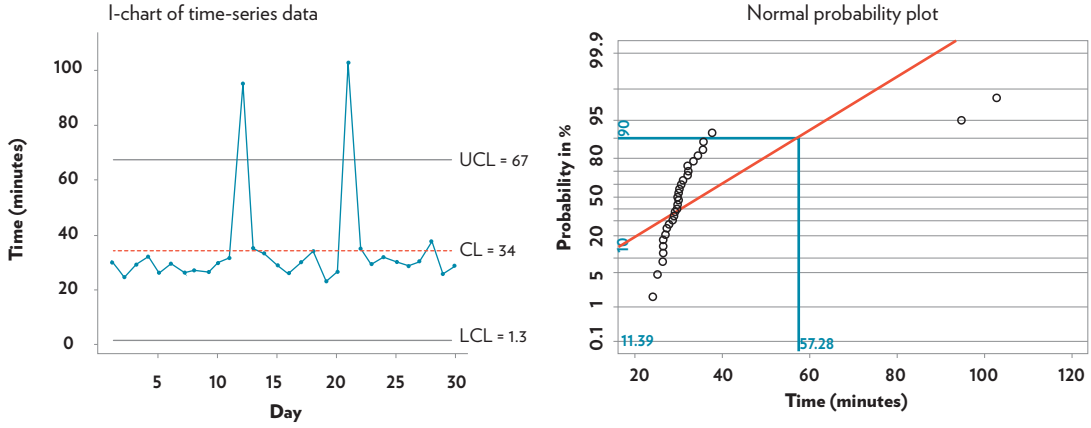
Includes a line for the not-to-exceed goal of 33 minutes



CL = center line

FIGURE 4

Commute time home to work: 30,000-foot-level reporting



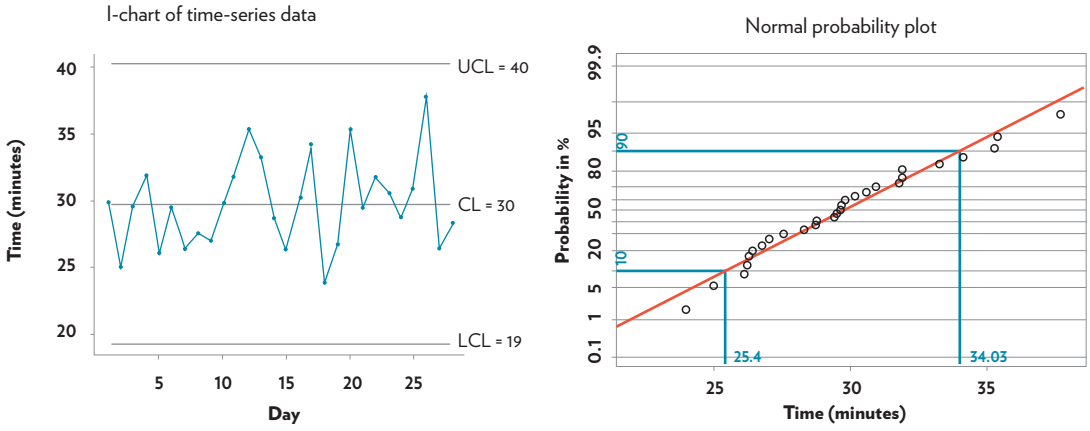
The current process response is not predictable.

No predictability estimate is possible

CL = center line **LCL**= lower control limit **UCL** = upper control limit

FIGURE 5

Commute time home-to work: 30,000-foot-level (two atypical commutes removed)



The current process response is predictable. The estimated mean is 29.72 with an 80% frequency of occurence between 25.4 and 34.03.

CL = center line **LCL**= lower control limit **UCL** = upper control limit

same as that of a statistical process control individuals control chart. The primary use of the individuals chart, however, is entirely different in a 30,000-foot-level report application.

With 30,000-foot-level reporting, you are not attempting to control a process and identify special-cause signals for resolution. With 30,000-foot-level reporting, the individuals chart only assesses whether a process is stable or not from a high-level vantage point. Suppose there are no points beyond the data-calculated upper control limit and lower control limit lines. In that case, the process is considered stable and predictable from this high-level perspective.

2. **The probability plot** (right graph) is a plot of data from the individuals chart. If a recent region of a process' output measurements is stable and predictable, the data for creating this plot are considered a random sample of future responses. This prediction statement assumes that future process inputs will be similar to those from the past.
3. **The statement** at the bottom of the chart addresses process predictability. If the process is considered stable, a prediction statement is determined from the probability plot and provided.

Figure 4 shows a commute time that is not stable because of the two abnormal commute times caused by a major traffic accident and a snowstorm. Because we want to reduce commute time under normal conditions and have identified the cause for these atypical responses, we can remove these two data points from our chart to create Figure 5.

From the individuals chart in Figure 5, you see the process is now considered stable; hence, the process is predictable. The bottom of the 30,000-foot-level report statement is that her current commute approach has an estimated mean response of about 30 minutes, with 80% (or four out of five) commute times between 25 and 34 minutes.

In this illustration, the commuter selected a process improvement to her commute process in which she departed home 30 minutes earlier than what she did previously. Figure 6 shows the resulting 30,000-foot-level chart for her compute time. This figure includes the times before and after her change in home departure times.

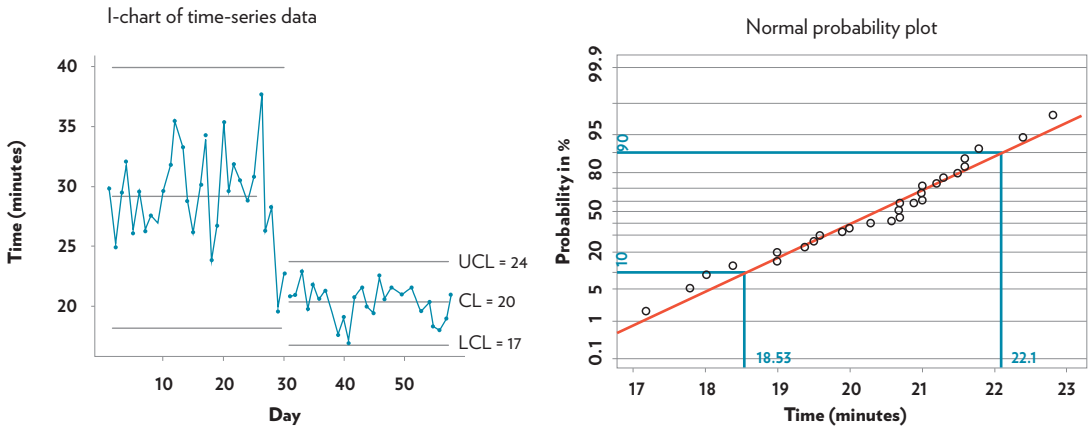
Figure 6 shows a staging of the individuals chart in which the commuter's new process began. This report-out's probability plot uses only data from the recent stability region to create the graph and provide the predictive statement details at the bottom of the report.

The commuter's new process (departing 30 minutes earlier) estimated mean commute time is about 20 minutes, with four out of five commute times (80%) between about 19 and 22 minutes. This mean-commute-duration time is much less (and with a lesser amount of variation) than her past process

FIGURE 6

Commute time home to-work: 30,000-foot-level report (two atypical commutes removed)

Includes responses after changing the process



The current process response is predictable. The estimated mean is 20.32 with an 80% frequency of occurence between 18.53 and 22.1.

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READ MORE

Quality consultant and author Forrest W. Breyfogle III has been a long-time contributor to QP, providing expertise and insight in articles for the Six Sigma Solutions (formerly known as 3.4 per Million) column over the years. Check out his previous work https://tinyurl.com/2x76u7dh.

(not departing earlier) estimated mean of 30 minutes, with four out of five commute times (80%) between 25 and 34 minutes.

Improving overall metric responses

Traditional metrics reporting often encourages reacting to the ups and downs of commonplace noise responses, leading to much organizational wasted efforts and even destructive behaviors. But 30,000-foot-level provides a high-level process output response viewpoint that encourages process improvement thinking to improve overall metric responses. QP

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6. Forrest W. Breyfogle III, "Free 30,000-foot-level creation app," 2020, https://smartersolutions.com/free-business-process-management-software.

Forrest W. Breyfogle III (Forrest@SmarterSolutions.com) is CEO of Smarter Solutions Inc. in Austin, TX, and holds a master of science degree in mechanical engineering from the University of Texas in Austin. An ASQ fellow, Breyfogle has authored or coauthored more than a dozen business management and process improvement books.